Assessment of the Potential for Color Overlays to Enhance the Reading Skills of Enlisted Navy Recruits

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EXECUTIVE SUMMARY

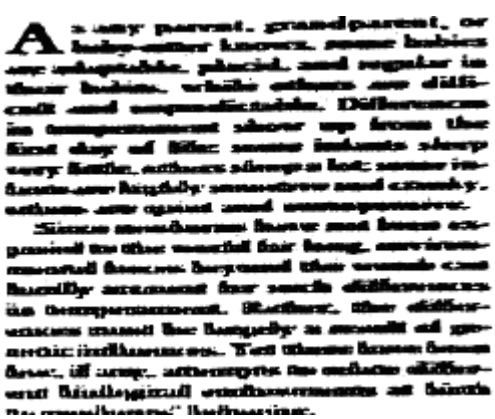
Meares Irlen Syndrome (MIS) is a perceptual difficulty associated with visual complaints that appear to be largely alleviated by individually selected color overlay(s) or tinted lenses. The current study was designed to assess the prevalence of MIS symptoms in Navy recruits and evaluate the effectiveness of color overlays in improving reading skills. Based on a self-reported questionnaire, 34.6 % of the enlisted Navy members were symptomatic of MIS, more than the number estimated in the general population. A subset of the sample with moderate to severe MIS symptoms was selected to evaluate the effectiveness of color overlays as an intervention. Readers with MIS symptoms read significantly faster with their chosen overlay than without it. These findings justify further research on overlays as a tool to improve reading skills in individuals with MIS symptoms.

INTRODUCTION

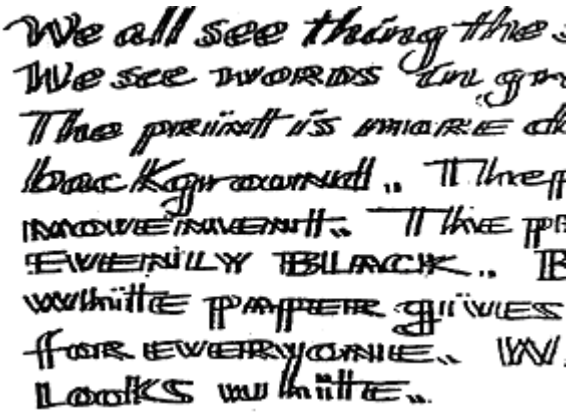
Meares-Irlen Syndrome (MIS) is a reading disability that can be eased by reading text through colored overlays. In 1983 Helen Irlen, an educational psychologist, explained this phenomenon and referred to it as "Scotopic Sensitivity Syndrome (SSS)." Since this condition was first described in detail by Olive Meares (1980, as cited in Stone, 2003), a school teacher in New Zealand, it appropriately came to be known as Meares-Irlen Syndrome.

According to Irlen (1991), individuals with MIS primarily experience perceptual distortions such as appearance of movement, blur, or dazzle in the printed text when reading (see Figure 1). They may also experience headaches and strained, tired, or sore eyes when reading. As a result, their attention span, motivation, and work production may be affected. MIS is found to be independent of vision corrections with eyeglasses or contact lenses, as well as corrections for binocular vision (Evans et al., 1995).

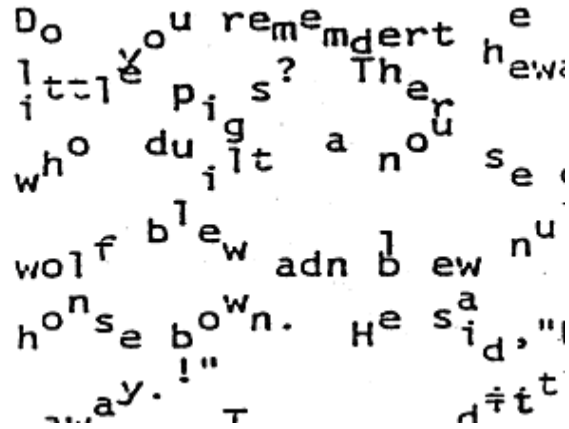
Children and adults with MIS are thought to be highly sensitive to particular wavelengths and frequencies of the white light spectrum. Therefore, bright lights, fluorescent lights, and glossy paper often make reading even more difficult since the increased contrast amplifies the problem of persistent images (Wood, 1999). In order to rectify this problem, Irlen (1991) developed a procedure for filtering parts of the light spectrum which appeared to be responsible for the visual difficulties experienced by these readers. The goal was to let in as much of the light spectrum as possible without including the parts of the spectrum that seemed to be inducing the problems. Different colors seem to improve the visual image for different individuals, while some colors seem to worsen the distortions. Color overlays are thought to be able to change the contrast between the words and the page and thus reduce or eliminate



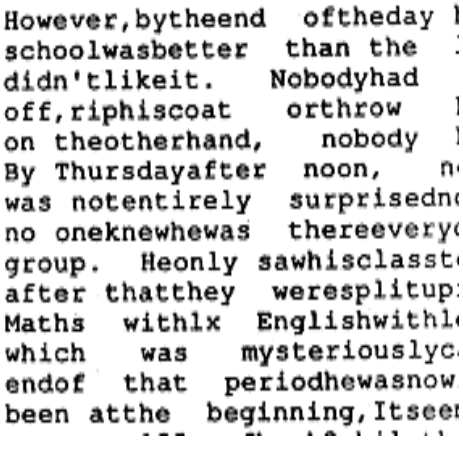
Blurry Effect



Halo Effect



Seesaw Effect



Rivers Effect

Figure 1. Examples of Visual Distortions Experienced by Individuals with MIS Symptoms

Reprinted from *Reading by the Colors* by Helen Irlen

the persistent images and help to see printed text more clearly (Reading & Writing Consultants Inc., nd).

There is little scientific rationale for expecting color to reduce visual distortions. Further skepticism has been fueled by Irlen's use of the term "Scotopic Sensitivity Syndrome" since scotopic refers to the activity of the rods, receptors that are activated at low levels of illumination and is not thought to be involved in color perception (Wilkins, 1996). However, recent evidence suggests that although the magnocellular system does not contribute to color perception, it may still receive summed input from all 3 classes of cone receptors (i.e., red, green, and blue) and differential dominance of the cone receptor inputs can result in visual distortions (Stein, 2003).

The phenomenon of MIS and the efficacy of the color overlays still continue to be controversial. Some doctors, such as Eli Peli, a low-vision specialist at the Schepens Eye Research Institute, argue that the efficacy of the color overlay is not justified by scientific research. According to Dr. Peli, in an effort to help poor readers, special-education teachers continue to use color overlays only because they believe it may help (Lee, 2004). Dr. John Ratey, a Harvard Medical School Psychiatrist who specializes in attention deficit disorders, also suggests that Irlen has grossly overestimated the number of people who can be helped by color overlays or filters and is making profit by offering false hope to many people with reading problems (Lee, 2004).

Irlen's research on MIS has been criticized for several reasons. Evans and Drasdo (1991) questioned Irlen's method for not having a sound theoretical basis for MIS and for not using scientific methods for collecting and analyzing data. By relying on anecdotal accounts or

experiments that lack adequate placebo controls, interpretations of Irlen's findings can be considered as speculative at best.

In the United Kingdom, Professor Arnold Wilkins (1994) of the MRC (Medical Research Council) Applied Psychology Unit, Cambridge and his colleagues offered a more scientific approach to study the effects of colored filters on MIS symptoms and reading performance. By using the first double masked, placebo controlled design, the results demonstrated significantly fewer symptoms when the correct colored lenses were used. Although this study by Wilkins et al. (1994) has been repeatedly cited as proof for the efficacy of colored filters for readers with MIS, placebo effects cannot be entirely ruled out from the results of this study.

However, other recent studies have demonstrated conclusive results and validated the use of color overlays and filters for readers with MIS. Tyrell, Holland, Dennis, and Wilkins (1995) found that children read significantly faster with a chosen colored overlay than without it. These effects took 10 minutes of reading time to occur which further verifies the claims of a progressive distortion of print frequently reported by subjects. Wilkins et al. (1996) also found an immediate and significant increase in reading speed when using color overlays and asserted that based on scientific evidence, color overlays provide a low-cost treatment option for readers with MIS. Bouldoukian, Wilkins & Evans (2002) further verified that improvement in reading speed through overlays could not be attributed to placebo effects or to optometric factors.

In recent years, the techniques for routine diagnosis and effective intervention methods for MIS have been improved and developed. Although Irlen is credited for the original MIS screening method, this method has also been widely criticized because the overlays supplied by the Irlen institute are often restricted to the members of Irlen's organization. More importantly,

these overlays do not sample chromaticity systematically, making it difficult to identify the appropriate color required to address some individuals' needs (Stone, 2002).

In response, Wilkins et al. (1996) developed the Intuitive Overlays which have been used in most research studies. A set of intuitive overlays consists of nine colors. These overlays are designed to sample colors comprehensively by producing a wide range of colors through combining the overlays by placing one over another.

Wilkins also developed the Rate of Reading Test (WRRT; Wilkins et al., 1996) to screen individuals with MIS. In this test, an individual reads a series of randomly ordered common words arranged in a paragraph printed in closely spaced font. Performance is scored based on the number of words correctly read in a minute. Since the test only requires basic word reading skills and little comprehension, performance in this test is relatively independent of cognitive skills (Bouldoukian et al., 2002). Compared to conventional reading tests, it takes only a few minutes to administer but is nonetheless sensitive enough to reveal the effects of color overlays. Wilkins et al. (1996) demonstrated the Rate of Reading test as a reliable and useful tool in assessing the benefit from color overlays.

Although the mechanisms underlying MIS is still questionable, increasingly convincing scientific evidence has accumulated over the past 20 years to support the conclusion that the reading ability of some individuals can be substantially enhanced if the text is viewed through transparent overlays that have appropriately designed colored tints (Stone, 2002). The estimated prevalence of MIS depends on the population sampled but ranges from about 15 to 20 percent for the general population to as high as 50 percent in students with reading disabilities (Stone, 2002).

Currently, many school systems in the U.S. and other countries have MIS screeners. In some school systems, all students referred for special education must be screened for MIS. MIS is also recognized by college testing organizations such as the ACT and the SAT (Stone, 2002).

Although the U.S. military has shown some recent interest in MIS, international military services are much more aware of this issue. The British Royal Navy, for example, screens for MIS on a case-by-case basis and provides overlays and filters as intervention. Furthermore, several high-profile members of the Royal Navy wear tinted filters or contact lenses on duty (British Royal Navy, 2005).

One of the few studies on MIS within the U.S. military includes a case study conducted by Irvine and Irvine (1997) at the Naval Air Warfare Center (NAWC) Weapons Division. This study tested a dyslexic subject to determine the legitimacy of MIS and develop an experimental methodology to quantify and investigate this phenomenon in Fleet personnel. The authors validated the phenomenon of MIS and demonstrated that energy spectrum presented to the eye of the subject is able to alter the subject's visual and cognitive performance to a significant extent. Irvine and Irvine (1997) further speculated that this phenomenon affects 10 to 20% of service personnel and consequently, affects training and performance of military service personnel. Based on this study, 10 to 20% of naval personnel could perform better if the lighting and the contrast between the paper and the printed material used in training are adjusted according to individual needs. The authors further speculated that this may significantly improve the performance of this subgroup of the training population at minimum cost and with no adverse effect on the rest of the training population.

Objective

The purpose of this study was to determine the prevalence of MIS in Navy recruits and evaluate the effectiveness of color overlays in improving reading skills. The results of this study will be used to raise awareness of MIS and its symptoms and the effectiveness of color overlays as an intervention to improve reading skills. This may eventually improve performance of affected personnel in both training and operational setting.

Military Significance

Performance and retention are the two major issues in personnel research. By raising awareness of MIS and its intervention, Navy recruits with MIS symptoms are more likely to read faster and more accurately and have fewer visual complaints which may enhance overall performance. Furthermore, alleviation of MIS symptoms can also provide relief from headaches, eyestrain, nausea, and fatigue and thus, improve the quality of life (Stone, 2003). Consequently, this may reduce attrition, increase retention, and thereby generate savings in training cost.

METHODS

Subjects

A total of 1,076 naval recruits from the Recruit Training Command, Great Lakes volunteered to participate in the study. Out of the total participants 86.4% were male (N = 929) and 13.6% (N = 147) were female. All of the participants passed recruit vision screening and did not have any uncorrected/uncorrectable visual defects. One of the participants did not complete all of the questions in section II of the questionnaire and was consequently excluded

from the final analysis. A subset of the participants with self-reported MIS symptoms was selected for further testing (see Figure 2).

Materials

Visual Stress Diagnostic Questionnaire. The MIS Screening Questionnaire (Appendix A) was based on a validated visual discomfort questionnaire used in the MIS research protocol at Essex University, Colchester, England. Based on the original questionnaire, 6 questions on brief personal and family history (Section I) and 31 questions regarding visual complaints when reading (Section II) were included in the questionnaire. An additional 20 questions regarding visual complaints during every day activities (Section III) were added to obtain supplemental information. However, analogous to the original questionnaire, only the responses to the questions regarding visual complaints when reading (Section II) were used to score the severity of MIS symptoms.

WRRT. Wilkins' Rate of Reading Test (WRRT; Appendix B) was developed by Wilkins (Wilkins et al., 1996) to measure reading speed and accuracy. In this test, an individual reads a series of randomly ordered common words arranged in a paragraph printed in closely spaced font. Performance is scored based on the number of words read correctly in a minute. Since the test only requires very basic word reading skills and little comprehension, performance in this test is relatively independent of cognitive skills (Bouldoukian et al., 2002).

Overlays. Intuitive Overlays are sheets of colored plastic designed to be placed over text. A set of overlays include nine colors: rose, blue, yellow, purple, mint green, lime green, pink, aqua, orange, and grey. The overlays are glossy on one side and matte on the other (i.e., glare vs. non-glare) which provides an additional choice on the reflective characteristics of the preferred overlay(s).

ASVAB. Armed Forces Vocational Aptitude Test Battery (ASVAB) is a generalized intelligence test required by all Navy recruits. The ASVAB measures verbal, math, and mechanical comprehension. The ASVAB (2004) scores on record for all the participants were obtained for the study. Additionally, a retired version of the ASVAB (1980) was used to retest Word Knowledge and Paragraph Comprehension sections of the ASVAB. Only the verbal sections of the ASVAB were selected for retest since MIS is associated with reading difficulty and therefore expected to primarily affect the verbal scores.

Procedures

Data collection for prevalence took place at the Recruit Training Command at Great Lakes, Illinois and intervention took place in the participants' respective "A" school in Great Lakes, Illinois, or in Pensacola, Florida. The participants were briefed on the study and asked to read and sign an Informed Consent form. They were then administered the Visual Stress Diagnostic Questionnaire. The questionnaire sections were read out aloud in consideration for the participants who may have reading difficulty.

Based on the original validated questionnaire, only the responses to Section II (visual complaints when reading) were used to classify the participants into a severe, moderate, and mild or asymptomatic category. The responses were rated based on the frequency (i.e., often, sometimes, or never) of the visual complaints (e.g., "Do your eyes skip around when you read?"). A response of "often" and "sometimes" were scored as 2 and 1, respectively, whereas a response of "never" and "don't know" were scored as 0. The scores from each of the 31 questions were then added to calculate the final score. A score between 35-62 was classified as severe, 19-34 was classified as moderate, and 0-18 was classified as mild or asymptomatic.

Following recruit training, 101 volunteers with severe to moderate MIS symptoms were selected from the total participants for further testing. In order to conserve time and resources only the participants who went to "A" school either in Great Lakes, Illinois or in Pensacola, Florida were selected for further testing. The participants were allowed to select the appropriate color overlay of their choice according to the instructions provided. From the set of overlays, the volunteers selected the color that seem to enhance the appearance of the text and then determined their preference for either the matte or gloss side of that color overlay. The individual choice of color was recorded on a record sheet (Appendix D).

After selecting the individually preferred overlay, reading performance with the selected overlays was then evaluated with the WRRT. The participants were administered 4 trials of the WRRT with 4 different versions of the test. The first and the last trials were always administered without overlay, whereas the second and the third trials were administered with overlay for all participants. The number of words read correctly in 1 minute in each of the trials was recorded on a record sheet (Appendix C).

Once the WRRT was completed, 51 out of the 101 participants were randomly provided with their overlay of choice (color group) and 50 participants were given a neutral density (ND) overlay (placebo group). The participants in the placebo group were told that the neutral density overlay is a composite of all colors and should help them read efficiently. The participants were instructed to use their overlay(s) for reading and classroom activities for a period of 7 to 10 days.

Approximately 7 to 10 days after the WRRT, the participants took the Word Knowledge and Paragraph Comprehension sections of the 1980 version of the ASVAB. The participants in the color group took the test with the color overlay that they had selected, whereas the

participants in the placebo group took the test with the assigned neutral density overlay. A group of 50 asymptomatic participants were also included as a control group (see Figure 2). The control participants were asked to take the ASVAB with their choice of overlay. All 151 participants retook the ASVAB under the same lighting conditions as existed in their classrooms, and they were granted identical time periods as had been allocated for the initial ASVAB test.

After the completion of the ASVAB retest, all the 101 participants with MIS symptoms were given an Overlay Follow-up Questionnaire that correlated to Section II of the original Diagnostic Questionnaire to compare answers between pre- and post-intervention.

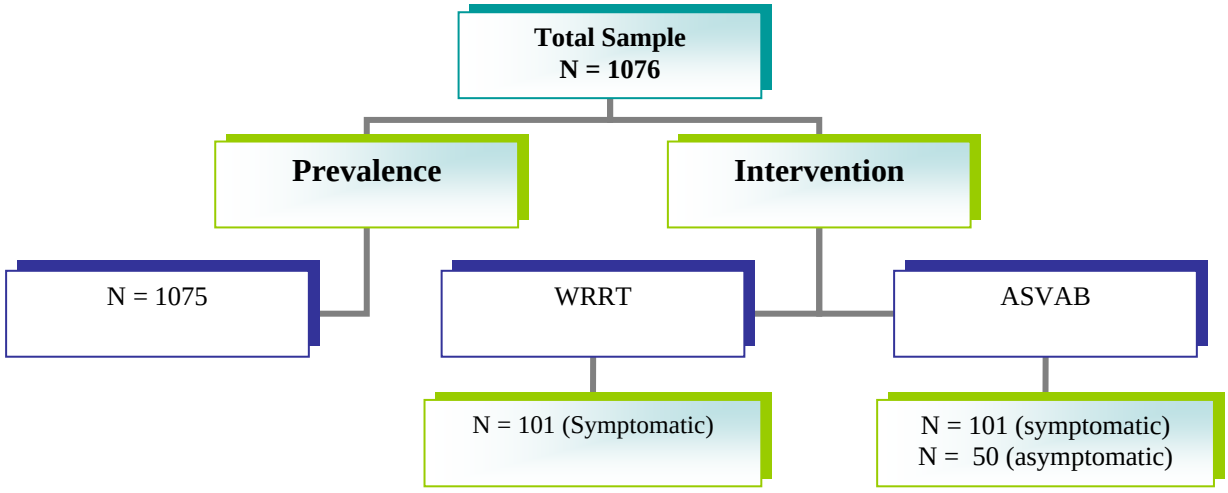


Figure 2. Distribution of the participants

RESULTS

The first approach taken in data analysis was to determine the prevalence of MIS symptoms by calculating the number of individuals within severe, moderate, and mild or asymptomatic category. The second approach was to determine the difference in reading speed with and without the overlays by using paired sample t-tests. The significance level was set at 0.05 for the t-test.

Prevalence

The participants were categorized as severe, moderate, and mild or asymptomatic based on their scores from Section II of the self-reported questionnaire. This section consisted of 31 questions and the score on each question ranged from 0 to 2 based on the frequency of the visual complaint. The scores from each of the questions were then added to calculate a final score. A total score of 0-18 was classified as mild or asymptomatic; a score of 19-34 was classified as moderate; and a score of 35-62 was classified as severe. Based on this scale, 34.6 % (N= 372) of the participants were identified as having MIS symptoms, of which 7.2% (N = 77) were categorized as having severe symptoms and 27.4% (N = 295) were categorized as having moderate symptoms.

Intervention

The WRRT test trials with and without overlay were combined and averaged to obtain mean WRRT score with and without overlay. Mean score without overlay was then subtracted from the mean score with overlay to calculate the difference in the number of words read correctly within the given time. The mean WRRT score with overlay was 149.39 (SD = 22.3), whereas the mean WRRT score without overlay was 143.37 (SD = 24.6). This difference was highly significant, t (100) = 5.7, p <.001. The improvement in reading speed did not differ

based on the severity of the symptoms, t (99) = .62, p > .05. However, it should be noted that the severe category only had 18 participants whereas the moderate category had 83 participants which did not allow a fair comparison between these groups. Interestingly, the WRRT score for the trials without overlay were virtually identical (trial 1: M = 143.5, SD = 25.2; trial 4: M = 143.2, SD = 24.9), whereas the score for the two trials with overlay were significantly different, t (100) = 5.4, p <.001. In other words, participants showed a higher reading speed when they used the overlay for the second time (see Figure 3). This implies that perhaps reading skill of MIS readers can improve progressively over time with overlays.

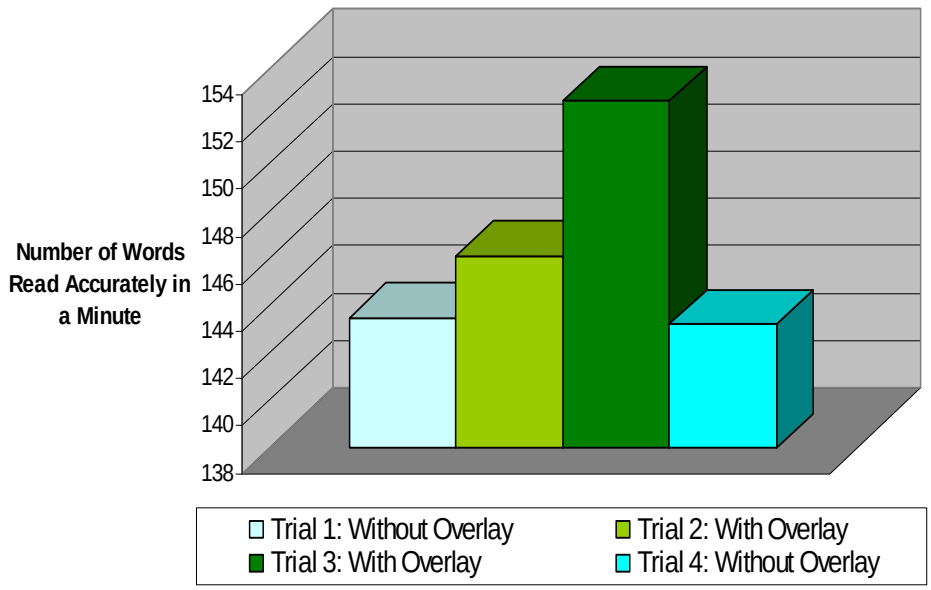


Figure 3. Improvement in Reading Speed with Overlay

The original ASVAB scores on record were compared among severe, moderate, and asymptomatic participants. There was no significant difference in ASVAB verbal subtest scores or in any of the other subtest scores (e.g., General Science, Arithmetic Reasoning, Math Knowledge, Electronic Information, Auto and Shop Information, and Mechanical Comprehension). Consequently, the participants with MIS symptoms are not any less likely to be assigned to highly desirable schools (e.g., submarines, nuclear, most electronics, etc.) that require an ASVAB score of at least 200.

A subset of the participants with MIS symptoms was tracked to estimate the percentage of MIS recruits assigned to higher level schools. We were able to track 230 of the 295 moderately symptomatic participants and found that out of those 230 participants, 38.7% (N = 89) were assigned to high-level schools. We were also able to track 55 out of the 77 severely symptomatic participants and found that out of those 55 participants 40% (N = 22) were assigned to high-level schools. This indicates that although many of our Sailors may be affected by MIS, they are still qualified to enter into higher-level academics. In other words, MIS can co-exist with other learning disabilities but it does not necessarily result in poor academic performance.

We were unable to perform a meaningful comparison between the ASVAB verbal scores before and after the intervention. A retired version of the ASVAB (1980) was administered in this study in order to preserve the integrity of the current ASVAB. However, we later recognized that the participants originally took the ASVAB after July 1, 2004 which was based on a new 1997 scale, whereas the ASVAB used for this study was based on legacy (1980) scale. Since we were unable to obtain the re-norming equivalency table for the ASVAB verbal section, it was not feasible to perform a comparison.

DISCUSSION

The purpose of this study was to determine the prevalence of MIS in Navy recruits and evaluate the effectiveness of color overlays to alleviate MIS symptoms. As the phenomenon of MIS has not been fully explored within the U.S. military population, the current study was designed to investigate the significance of MIS in Navy recruits.

The results of this study demonstrated that about 1/3 of the Navy recruits had MIS symptoms based on their self-report. The results also suggested that color overlay can be an effective intervention to improve reading speed in MIS readers. The significant increase of WRRT scores with overlay confirmed the immediate improvement with overlays reported in previous literature.

Based on the results of the study, several no-cost interventions such as dimming classroom lights to reduce glare, permitting students to temporarily change background color on assigned computers, etc. should be considered to benefit the recruits with MIS symptoms

The current study, however, has several limitations. Even though all the participants went through recruit vision screening, further testing is needed to confidently differentiate MIS from other optometric conditions such as refractive error, binocular vision anomalies, and accommodative anomalies. Furthermore, the presence of other learning disabilities need to be assessed as MIS can coincide with other learning disabilities.

One of the major limitations of the study was the lack of a control group for the WRRT. As we did not test asymptomatic individuals with the WRRT as a control group, the possibility of a placebo effect cannot be excluded from this study. Future studies on MIS should include

control conditions with asymptomatic participants as well as other control such as varying lighting conditions to further evaluate the effectiveness of the color overlay.

Due to time constraints, this study only included a mechanical reading test to assess the effectiveness of the overlays. However, improvement in reading speed may not be meaningful unless it also involves comprehension. Future studies should therefore include a comprehensive reading aptitude test such as the Gates-MacGinitie Reading Test (GMRT) which is designed to measure both reading ability and comprehension.

Another concern in this study is that after the overlays were issued for 7-10 days, many participants had reported not having used the overlay as often as instructed primarily because of inconvenience. Future studies should evaluate the effectiveness of intervention beyond color overlays, preferably filters (i.e., glasses) or colored contact lenses which are more convenient and suitable to use for a longer period of time.

CONCLUSIONS

The results of this study suggest that a substantial number of Navy recruits are affected by MIS symptoms and further exploration of this issue is warranted. Based on these results, faster reading can be expected from MIS readers with their chosen color overlays. However, due to the limitations of this study we cannot confirm that overlays can improve overall reading aptitude including comprehension which ultimately affects performance in training and operational setting. The results of this preliminary study should be used to raise awareness of MIS and initiate further research on MIS with Navy recruits.

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APPENDIX A

Name_____

Social Security Number_____

Division_____

Visual Stress Diagnostic Questionnaire

Section I

I am going to ask some questions about you and your family history. Please follow along and mark your answer in the appropriate box. There are no right or wrong answers, but it would be of most help to you to answer as honestly as you can. Please answer the following questions

Yes, No, or You don't know.

Questions	Yes	No	Don't Know
1. If you are wear glasses, are you using your most recent prescription?			
2. If you have previously been assessed for dyslexia/dyslexic tendencies, was the result positive? [In other words, were you told you were dyslexic by whoever tested you?]			
3. Do you find it easier to read things on a colored background instead of a white background?			
4. Have you been issued colored overlays or lenses in the past to help your reading?			
5. Is there a history of reading problems in your family?			
6. Is there a history of migraine in your family?			

Section II

Now I'm going to ask you some more questions about what happens when you read (under normal lighting conditions, when you're not tired, and when you're wearing your glasses/contact lenses, if that's applicable). Again, there are no right or wrong answers. Listen carefully and answer as honestly as you can. In this section, please answer the following questions according to whether the statement is:

Often true, Sometimes true, Never true, or You don't know.

Questions	Often	Some-times	Never	Don't know
1. Do you tend to avoid reading tasks and/or close work?				
2. Do your eyes skip around when you read?				
3. When reading, do you leave words out or add words in without meaning to?				
4. Do you leave out whole lines or sentences without meaning to?				
5. Do you have trouble keeping your place when reading?				
6. Do you misread words or read them incorrectly?				
7. Do you repeat or reread the same word or words without meaning to?				
8. Do you put words from neighboring lines into the line that you are reading?				
9. Do you use your finger, pencil, or any other marker to keep your place?				
10. Do you find black print on white paper uncomfortable to read?				
11. Do you find reading under fluorescent light to be tiring or uncomfortable?				
12. Do you prefer to read in dim light?				
13. Do you need to take breaks or keep looking away from the text when reading?				

Questions	Often	Some-times	Never	Don't know
14. Do you become easily distracted when you read? [That is, do you have a short attention span?]				

Questions	Often	Some-times	Never	Don't know
15. Do you have to strain to keep looking at the words after you have been reading for a while?				
16. Do you find it becomes harder to read the longer you have been reading?				
17. Do you feel that you do not understand things that you have just read?				
18. Do you find it hard to remember things you have just read?				
19. Does print appear blurry, fuzzy, fizzy, or sparkly?				
20. Does print appear to move, change, float above or fall off the page?				
21. Do you experience double vision [that is, see a single thing as two identical or overlapping things] when you read for a while?				
22. Do you feel any discomfort in your eyes when reading? [For example, do they get red and watery, burn, or sting?]				
23. Does reading make you want to rub your eyes or the area around your eyes?				
24. Does reading make you feel tired or drowsy?				
25. Does reading and/or close work make you feel dizzy, sick or nauseous?				
26. Do you get headaches when you read and/or do close work?				
27. Do you find yourself squinting, frowning, or closing one eye to focus when you read?				
28. Do you find yourself blinking a lot when you read?				
29. Do you open your eyes wide when you read?				
30. Does your head change position [tilt, for example] in relation to the page for reading, or do you prefer to hold the reading material at an unusual angle?				
31. If you wear glasses, do you have any difficulty with vision that the glasses do not adequately correct?				

Please add up the number of checks in each column, and place that number in the bottom row of each column where it says "Total Checks." So, if you have 15 questions that are "often true" and 10 questions that are "sometimes true," you would put the number 15 in the "Total Checks" column under "1," the number 10 in the "Total Checks" column under "2," and so on.

Total checks				
X	2	1	0	0
Total category points				

Total points _____

Questionnaire Score

35 – 62	☐	**Severe problem**
19 – 34	☐	**Moderate**
≤ 18	☐	**Few problems**

Section III

Finally, the last group of questions. These are a little more specific. Again, there are no right or wrong answers. Just listen carefully and answer as best you can using the following responses:

Often true, Sometimes true, Never true, or You don't know

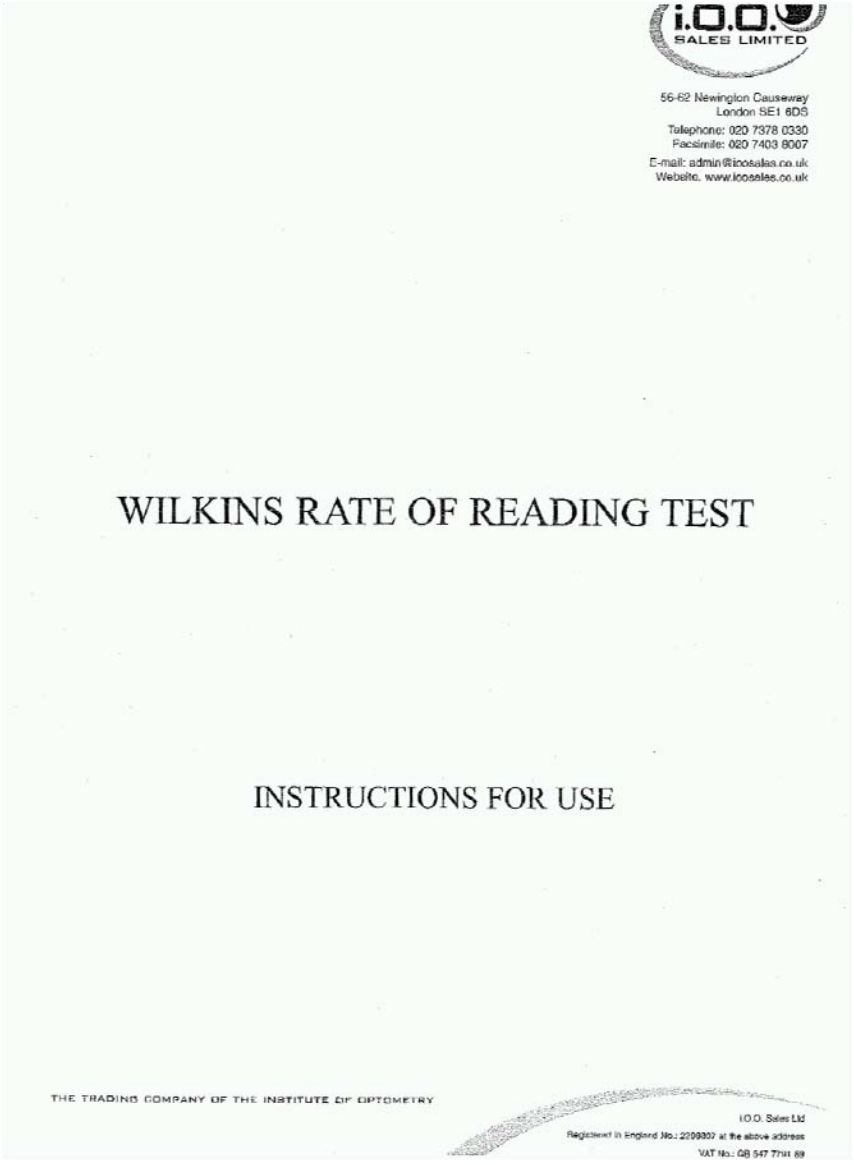
Questions	**Often**	**Some-times**	**Never**	**Don't know**
1. Do you understand better when you read out loud?				
2. Do you understand better when listening to someone else read to you?				
3. Do words seem to run together when you read?				
4. Does your vision seem worse at the end of the day?				
5. Do you have difficulty copying from the chalk- or whiteboard?				
6. Do you have a tendency to write "uphill" or "downhill"?				
7. Do you tend to misalign digits in columns of numbers?				
8. Do you find yourself holding reading material too close?				
9. Do you have difficulty completing assignments in reasonable time?				
10. Do you have trouble with inconsistent or poor sports performance?				
11. Do you avoid playing sports or games?				
12. Do you tend to say, "I cannot" before trying to do something?				
13. Do you have difficulty with time management?				
14. Do you have difficulty with hand tools (such as scissors, screwdrivers, and keys)?				
15. Do you have an unusual pencil grip?				
16. Do you find it difficult to estimate distances accurately?				
17. Do you have a tendency to knock things over?				
18. Do you misplace or lose papers, objects, or belongings?				

Questions	Often	Some-times	Never	Don't know
19. Do you have a poor memory or do you seem to be forgetful?				
20. Can you study easily with background noise?				

And, again, please add up the number of checks in each column, and place that number in the bottom row of each column where it says "Total Checks," just like you did in the last section.

Total Checks				

APPENDIX B



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WILKINS RATE OF READING TEST

INSTRUCTIONS FOR USE

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Rate of Reading Test

A.J.Wilkins, R.J.Jeanes P.D. Pumfrey and M. Laskier

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University of Manchester

Introduction

The *Rate of Reading Test* is designed to measure the effects on reading of visuo-perceptual distortions of text, such as apparent movement of the words and letters, blurring and coloured halos. Patients are required to read text that looks like a passage of prose, but consists of random words. The reading is independent of syntactic and semantic constraints but requires all the usual visual and visuo-perceptual processing.

The *Rate of Reading Test* is used to compare an individual's performance under one set of visual conditions with that under another. For example, the test might be used to compare the effects on reading with and without coloured overlays.

The test is not a conventional reading test in which the words become progressively more difficult. Such tests usually compare an individual's performance with that of other individuals of similar age, and express the performance in terms of a "reading age". In the *Rate of Reading Test*, reading ability is assessed in terms of rate and errors rather than in terms of the difficulty of the words read. All the words are of very high frequency in the English language and should be familiar to children of age 7 and above, as well as adults.

The individual is required to read the text aloud as rapidly as possible. The reading is timed and errors are noted.

Multiple versions of the test are available so that the reading of equivalent passages can be assessed under different visual conditions.

Performance of the *Rate of Reading Test* is reliable on retest, but is not strongly correlated with age, or with performance on other more conventional reading tests (Wilkins *et al.*, 1996).

There is no evidence that individuals who read faster do so because they

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tolerate a greater number of errors. In general, the conditions that give rise to errors also give rise to slower reading (*Wilkins et al., 1996*).

References

Wilkins, A.J. , Jeanes, R.J., Pumfrey, P.D. and Laskier, M. (1996). Rate of Reading Test: its reliability, and its validity in the assessment of the effects of coloured overlays. *Ophthalmic and Physiological Optics*, in press.

Administration and scoring

1. The reading test can only be given to patients who can correctly read the words printed in large type. Ask the patient to read aloud all the words printed in large type. If there are errors, correct them, and ask the patient to re-read the words. If the patient continues to make errors, stop the test at this stage.

2. Tell the patient the task is to read a passage with just these words in. (S)he has to read the words aloud as quickly as possible without errors.

3. Choose Version A of the test with the small typeface, unless the patient is unable to read it, or it causes pain.

4. Note the patient's name, date of testing, and the preferred overlay colour on the score sheet.

5. Place the preferred overlay on the text.

6. Start a stopwatch as you instruct the patient to begin.

7. As the patient reads, note each error by marking the score sheet above the word that is misread. Use any marking system that suits you.

8. Stop the patient after 1 minute and mark the score sheet with an oblique line (/) to indicate how far (s)he read. If (s)he finishes the passage before the

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minute is up, then note how many seconds were taken to read the passage. It is difficult to watch the time and note the errors. Keep the stopwatch where you can see it out of the corner of your eye.

Most of the errors will occur when readers lose their place and skip or repeat words or lines. Other errors will be intrusions that may subsequently be corrected.

9. Place Version B in front of the patient, but **without** the overlay on top.

10. Repeat Steps 6-8.

11. Place Version C in front of the patient, again **without** an overlay on top.

12. Repeat Steps 6-8.

13. Place Version D in front of the patient **with** the preferred overlay on top.

14. Repeat Steps 6-8.

15. Calculate the number of words correctly read per minute for each passage. Most errors will tend to decrease the words-per-minute, either by reducing the number of words correctly read, or by increasing the time taken to read them.

If the patient finished the passage before the minute was up, then calculate the words-per- minute as follows:

$$\frac{60 \times (\text{total number of words correctly read})}{(\text{total time taken, in seconds})}$$

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16. Average the words-per-minute for the two tests without the overlay. Average the words-per-minute for the two tests with the overlay. The two averages will reflect the reading rate under these two conditions, and the effects of practice and fatigue will have been largely balanced out.

NOTE

Reading can be stressful. If the patient experiences pain, stop the test. It is still possible to calculate a reading rate if you have to stop the test. Simply count the words successfully read before the test was stopped, and note the time taken to read them. Use the formula in Step 15 above.

APPENDIX C

Wilkins Rate of Reading Test Record Sheet

Name: _____ Date: _____

Version A **With Overlay, colour:**_____

come see the play look up is cat not my and dog for you to
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

the cat up dog and is play come you see for not to look my
16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

you for the and not see my play come is look dog cat to up
31 32 33 34 35 36 37 38 39 40 41 42 43 44 45

dog to you and play cat up is my not come for the look see
46 47 48 49 50 51 52 53 54 55 56 57 58 59 60

play come see cat not look dog is my up the for to and you
61 62 63 64 65 66 67 68 69 70 71 72 73 74 75

to not cat for look is my and up come play you see the dog
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90

my play see to for you is the look up cat not dog come and
91 92 93 94 95 96 97 98 99 100 101 102 103 104 105

look to for my come play the dog see you not cat up and is
106 107 108 109 110 111 112 113 114 115 116 117 118 119 120

up come look for the not dog cat you to see is and my play
121 122 123 124 125 126 127 128 129 130 131 132 133 134 135

is you dog for not cat my look come and up to play see the
136 137 138 139 140 141 142 143 144 145 146 147 148 149 150

Words-per-minute

.....

Version B **Without Overlay**

see the look dog and not is you come up to my for cat play
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

not up play my is dog you come look for see and to the cat
16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

look up come and is my cat not dog you see for to play the
31 32 33 34 35 36 37 38 39 40 41 42 43 44 45

my you is look the dog play see not come and to cat for up
46 47 48 49 50 51 52 53 54 55 56 57 58 59 60

for the to and you cat is look up my not dog play see come
61 62 63 64 65 66 67 68 69 70 71 72 73 74 75

you look see and play to the is cat not come for my up dog
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90

come not to play look the and dog see is cat up you for my
91 92 93 94 95 96 97 98 99 100 101 102 103 104 105

and is for dog come see the cat up look you play my not to
106 107 108 109 110 111 112 113 114 115 116 117 118 119 120

dog you cat to and play for not come up the see look my is
121 122 123 124 125 126 127 128 129 130 131 132 133 134 135

the come to up cat my see dog you not look is play and for
136 137 138 139 140 141 142 143 144 145 146 147 148 149 150

Words-per-minute

.....

APPENDIX D

Intuitive Overlays Record Sheet

Name : ..... Date : .....

Date of Birth : ..... Male/female

Class : ..... Examiner's initials.....

Symptom Questionnaire

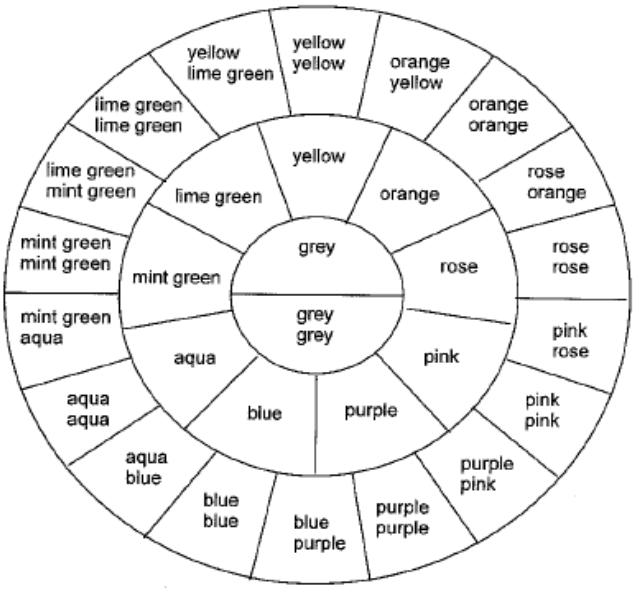
Ask question when individual is looking at text on Test Page.
*Response that is **underlined** scores 1; others score 0.*
Enter score in box.

	White page	Single overlay	Double overlay
"Do the letters stay still or do they **move**?"			
"Are the letters clear or are they **blurred**?"			
"Are the words **too close together** or far enough apart?"			
"Is the page **too bright**, not bright enough, or just about right?"			
"Does the page **hurt** your eyes to look at, or is it OK?"			

There is no hard and fast rule relating the above symptoms to benefit from overlays, although, in general, the greater the number of symptoms reported, the greater their reduction with the optimal colour, the more likely it is that the overlay(s) will be used, and the greater the increase in reading speed that results. See Wilkins, A.J. Lewis, E., Smith, F. Rowland, E., Tweedie, W. (2001). Coloured overlays and their benefit for reading. *Journal of Research in Reading*, **24**, 41-64.

Colour of single overlay ..... Colour of double overlay (if needed).....

You can use this diagram to keep track of the overlays and combinations of overlays you have tested. The colours formed by the single overlays are shown in the inner ring. The colours given in the outer ring are formed by placing one overlay on top of another. Grey overlays are only rarely of benefit.



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14. ABSTRACT

Meares Irlen Syndrome (MIS) is a perceptual difficulty associated with visual complaints that appear to be largely alleviated by individually selected color overlay(s) or tinted lenses. The current study was designed to assess the prevalence of MIS symptoms in Navy recruits and evaluate the effectiveness of color overlays in improving reading skills. Based on a self-reported questionnaire, 34.6 % of the enlisted Navy members were symptomatic of MIS, more than the number estimated in the general population. A subset of the sample with moderate to severe MIS symptoms was selected to evaluate the effectiveness of color overlays as an intervention. Readers with MIS symptoms read significantly faster with their chosen overlay than without it. These findings justify further research on overlays as a tool to improve reading skills in individuals with MIS symptoms.

15. SUBJECT TERMS
Meares Irlen Syndrom, MIS, color overlay, Scotopic Sensitivity Syndrome, SSS

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